

CLAIMS

1 1. An information storage and searching device, the device comprising:
2 a buffer for storing data to be searched,
3 a barrel shifter operably controllable to select at least a portion of the buffer's
4 contents; and
5 a storage facility coupled to the barrel shifter so as to receive the selected portion
6 of the buffer's contents, the storage facility having a plurality of associative memories
7 arranged in a cascading fashion such that the output from an upstream associative mem-
8 ory is provided to at least one downstream associative memory, the associative memory
9 being loaded with information against which data in the buffer is to be matched, wherein
10 the information is translated into a Boolean function prior to being loaded
11 into the associative memories, and
12 each associative memory stores a segment of the Boolean function.

1 2. The information storage and searching device of claim 1 further wherein the
2 barrel shifter inputs a different portion of the buffer's contents into each associative
3 memory.

1 3. The information storage and searching device of claim 2 further wherein each
2 downstream associative memory compares its segment of information against the output
3 from its respective upstream associative memory and the selected portion of the buffer's
4 contents.

1 4. The information storage and searching device of claim 3 further wherein
2 each associative memory has a plurality of entries,

3 the storage facility further comprises a plurality of secondary memories each
4 having a plurality of storage locations, and

5 each secondary memory is associated with a corresponding associative memory
6 such that each associative memory entry identifies a particular storage location of its as-
7 sociated secondary memory.

1 5. The information storage and searching device of claim 4 further wherein the
2 Boolean function is a Binary Decision Diagram (BDD), and each associative memory
3 stores a different BDD segment.

1 6. The information storage and searching device of claim 5 wherein each associa-
2 tive memory is a ternary content addressable memory (TCAM) supporting don't care
3 values.

1 7. The information storage and searching device of claim 6 further comprising a
2 controller operatively coupled to the barrel shifter, the controller configured to direct the
3 barrel shifter to retrieve a selected portion of the buffer's contents.

1 8. The information storage and searching device of claim 7 wherein the informa-
2 tion stored in the TCAMs corresponds to one or more access control lists (ACLs), and the
3 data stored in the buffer corresponds to a network message.

1 9. A method of loading a storage facility having a plurality of associative memory
2 stages with information to be matched, the method comprising the steps of:

3 translating the information into a Binary Decision Diagram (BDD), the BDD
4 having a plurality of nodes interconnected by arcs and one or more results;

5 cutting the BDD into a plurality of segments such that the number of BDD seg-
6 ments corresponds to the number of associative memory stages in the storage facility;
7 assigning a value to each BDD node reached by an arc crossing a cut;
8 computing one or more coverages for each BDD segment such that the output of
9 the coverage are either the values assigned to the BDD nodes in the next adjacent BDD
10 segment or the results of the BDD;
11 loading each associative memory stage with the one or more computed coverages
12 for the respective BDD segment; and
13 loading each associative memory stage with either the values assigned to the BDD
14 nodes in the next adjacent BDD segment or the results of the BDD.

1 10. The method of claim 9 wherein
2 the BDD includes a set of variables and each BDD segment includes a sub-set of
3 the variables, and
4 each computed coverage has as its variables, the sub-set of variables from the cor-
5 responding BDD segment.

1 11. The method of claim 10 wherein
2 each associative memory stage includes a corresponding secondary memory hav-
3 ing a plurality of storage locations, and
4 the values assigned to the BDD nodes reached by arcs crossing a cut and the re-
5 sults of the BDD are loaded into the storage locations of the secondary memories.

1 12. The method of claim 11 wherein the associative memories are ternary content
2 addressable memory (TCAM) supporting don't care values.

1 13. The method of claim 12 wherein the information stored in the TCAMs corre-
2 sponds to one or more access control lists (ACLs), and the data being matched against the
3 contents of the TCAMs corresponds to a network message.

1 14. An intermediate network device for use in processing and forwarding network
2 messages in a computer network, the intermediate network device comprising:

3 a plurality of ports for connecting the device to the computer network, each port
4 configured to receive and forward network messages;

5 a forwarding entity coupled to the ports for processing the network messages; and

6 an information storage and searching device coupled to the forwarding entity for
7 receiving one or more of the network messages, the information storage and searching
8 device comprising:

9 a buffer for storing the one or more network messages,

10 means for selecting at least a portion of the buffer's contents; and

11 a storage facility coupled to the selecting means so as to receive the se-
12 lected portion of the buffer's contents, the storage facility having a plurality of as-
13 sociative memories arranged in a cascading fashion such that the output from an
14 upstream associative memory is provided to a downstream associative memory,
15 the associative memories being loaded with information against which data in the
16 buffer is to be searched, wherein

17 the information is translated into a Boolean function prior to being
18 loaded into the associative memories, and

19 each associative memory stores a segment of the Boolean function.

1 15. The intermediate network device of claim 14 wherein the selecting means of
2 the information storage and searching device inputs a different portion of the buffer's
3 contents into each associative memory.

1 16. The intermediate network device of claim 15 wherein the Boolean function is
2 a Binary Decision Diagram (BDD), and each associative memory stores a different BDD
3 segment.

1 17. The intermediate network device of claim 16 wherein the associative memo-
2 ries are ternary content addressable memory (TCAM) supporting don't care values.

1 18. A computer readable medium containing executable program instructions for
2 loading a storage facility having a plurality of associative memory stages with informa-
3 tion to be matched, the executable program instructions comprising steps for:

4 loading a storage facility having a plurality of associative memory stages with in-
5 formation to be matched, the method comprising the steps of:

6 translating the information into a Binary Decision Diagram (BDD), the BDD
7 having a plurality of nodes interconnected by arcs and one or more results;

8 cutting the BDD into a plurality of segments such that the number of BDD seg-
9 ments corresponds to the number of associative memory stages in the storage facility;

10 assigning a value to each BDD node reached by an arc crossing a cut;

11 computing one or more coverages for each BDD segment such that the output of
12 the coverage are either the values assigned to the BDD nodes in the next adjacent BDD
13 segment or the results of the BDD;

14 loading each associative memory stage with the one or more computed coverages
15 for the respective BDD segment; and

16 loading each associative memory stage with either the values assigned to the BDD
17 nodes in the next adjacent BDD segment or the results of the BDD.

1 19. The computer readable medium of claim 18 wherein each BDD segment in-
2 cludes a plurality of variables and the one or more coverages for a given BDD segment
3 has as inputs the values assigned to the BDD nodes within the given BDD segment that
4 are reached by arcs from the previous BDD segment, and the variables within the given
5 BDD segment.